

(12) **UK Patent Application** (19) **GB** (11) **2 363 049** (13) **A**

(43) Date of A Publication 12.12.2001

(21) Application No 0013685.3

(22) Date of Filing 05.06.2000

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(51) INT CL⁷

A23P 1/08 , A23G 3/00

(52) UK CL (Edition S)

A2B BKP1 BMC2

(56) Documents Cited

EP 0421509 A1 EP 0162644 A2 US 4748031 A

(58) Field of Search

**UK CL (Edition R) A2B BKP1 BKP9 BKPX BMC12 BMC2
BMF1 BMF11 BMP1 BMP5 BMS1
INT-CL⁷ A21C 3/04 11/16 , A21D 13/00 13/08 , A23G
3/00 9/00 , A23P 1/08 1/12
Online: EPODOC, WPI, JAPIO**

(54) Abstract Title

Extruded food with moisture barrier

(57) An extruded food product comprises a higher water component encased by a barrier portion with a water activity of 0.93 or less, which is in turn encased by a lower water component, the barrier portion capable of restricting migration of water from the higher water to the lower water components. The high water, barrier and low water components are preferably coextruded. The barrier portion may contain a fat or fat-continuous emulsion, marzipan, jam, gelatin, gum, methyl cellulose, protein, edible wax or shellac. The lower water component can be based on dough, cereal, egg, chocolate, recombined fruit, sugar, nut or gum. The high water component is preferably either a dairy, fruit, vegetable, fish, meat, sauce, dessert or pudding based composition, and optionally has a humectant. The food product may be a sweet or savoury snack food.

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SNACK FOOD PRODUCT

The present invention relates to food products generally having a filling with a higher moisture content and a lower moisture content coating. In particular the invention relates to food products of this type having a barrier layer for controlling water migration between high moisture and low moisture regions of the product, and for ensuring microbiological stability. The invention also relates to processes for producing such products.

In the modern world there is a trend away from formal meals to the consumption of snacks ("grazing") and lighter meals. There is therefore a need for food products that are suitable for eating as snacks and that are perceived to be healthy. To be suitable for eating as snacks they must be fairly small and portable and they should have the characteristics of size and texture normally associated with snacks. A number of products suitable for use as hand-held snacks are disclosed in the prior art.

WO-A-9835566 (Compagnie Gervais Danone) discloses food compositions consisting of a premoulded coating, which may be chocolate, and a dairy filling in the form of an oil-in-water emulsion, which may be whipped. The dairy filling contains one or more sugars or polyols in amorphous form, a texturising system and optionally flavourings, and has a water activity (aW) of 0.8 to 0.96, preferably not less than 0.82. The product has a shelf life of, for example, 28 days at 6°C.

WO-A-9522906 (Compagnie Gervais Danone) discloses food compositions consisting of a chocolate or biscuit coating in the form of a finger or shell containing a dairy filling and sufficient fat for a water-in-oil emulsion to be formed. The dairy filling may be fermented, in which case it contains live lactic acid bacteria and has a water activity (aW) of 0.75 to 0.86, and the whole product is equilibrated to an aW of 0.75 to 0.81.

FR-A-2609871 (Convent Knabber-Gebäck) discloses food compositions in the form of a bar consisting of an extruded cylindrical casing with longitudinal slots and a fatty cream filling which may contain added dairy powders to stabilise it.

EP-B-0064155 (Ferrero) discloses confectionery products consisting of a shell formed by two wafer half-shells and a filling which is covered by an edible water-impermeable capsule in order to prevent water migration from the filling to the wafer shell. The edible water-impermeable capsule may be made from chocolate, a butter/milk protein mixture or a fatty cheese.

The products described above are usually of the confectionery type and are not seen as

healthy snacks. There are also products such as energy bars, but these have a rather limited appeal to most consumers. There is therefore a need for a hand-held snack that is perceived by consumers as being healthy and as being suitable for use between meals, or as part of a meal, or in a lunch-box.

A particular limitation of known snack products is that it has not previously been possible to combine a high moisture filling with certain low moisture coatings because of the problem of water migration from the filling to the coating. Water migration can lead to the outer layer becoming soft or soggy, which may also promote bacterial growth and shorten the shelf life of the product. In addition it was not previously thought to be possible to form an extruded food product with a barrier protecting an inner layer from an outer layer, since extrusion tends to leave gaps in the barrier layer at some points, especially the ends of the extruded product.

The present invention aims to solve the problems associated with the prior art products. In particular the present invention aims to provide an extruded food product, and especially a snack product, with a high moisture content filling, protected by a barrier.

Accordingly, the present invention provides an extruded food product comprising a higher water component, a lower water component and a barrier portion separating the higher water component and the lower water component, wherein the barrier portion has a water activity of 0.93 or less, the barrier portion is capable of restricting the migration of water from the higher water component to the lower water component, the barrier portion substantially encloses the higher water component, and the lower water component substantially encloses the barrier portion.

"Restricting" in the context of the present invention means hindering or slowing down the migration of water between components. "Separating" in the context of the present invention means that the higher water component and the lower water component substantially do not contact each other so there is little or no transfer of water.

The present invention also provides a process for preparing a food product as defined above, wherein the higher water component, the lower water component and the barrier portion are formed separately and then co-extruded to form the food product, such that the barrier portion substantially separates the higher water component and the lower water component.

The food products of the present invention have advantageous qualities over those of the

prior art, because the barrier restricts the migration of water between the components. This allows components which would otherwise be incompatible with each other to be combined in a single product. The presence of the barrier portion allows a component with a high water activity to be incorporated into the product. Therefore lower-fat (higher moisture) compositions, such as low-fat dairy products, can be included. Dairy products are generally seen as healthy products, especially if they do not contain too high a fat content, and are thus suitable for incorporating as part of a healthy snack food product.

Furthermore the food products of the present invention are advantageous in that they may be manufactured by an extrusion process. The applicants have surprisingly found that the food products of the present invention may be produced by co-extrusion of the components, allowing a product to be formed wherein the higher water component is completely enclosed by the barrier portion and the barrier portion is completely enclosed by the lower water component. The extrusion process of the present invention provides an efficient method of combining the components to form the final food product, while forming the barrier material into a continuous layer separating the higher and lower water components. It also allows the product to be formed into a variety of different shapes, such as bars suitable for use as snacks.

The food product is preferably a chilled product, stored under refrigeration, but may also be a frozen product or an ambient product. It is not necessary that the product is required to be stored under refrigeration, and the product may merely be stored under refrigeration to improve its appearance to the consumer. However, in some embodiments of the present invention, the product may comprise a perishable component which needs to be stored under refrigeration. Typically the chilled snack food product will have a shelf life of between 7 and 30 days when stored under refrigeration.

The food product may be either a sweet product or a savoury product. It may be a crispy product or a chewy product. The food product is preferably a hand-held product such as a bar but the size and shape of products according to the invention may vary considerably, ranging from small balls to large bars. Products that are not suitable for holding in the hand for eating may be consumed using cutlery, for instance as part of a meal. Such products may be heated before consumption and consumed as a hot food.

The lower water content component functions to protect the bar physically and to add texture. It completely contains the higher water component, which is typically of a softer texture that needs to be contained or supported. By completely contains it is meant that if the food product of the invention is for example in the shape of a bar, then the outer layer

covers the whole of the surface of the bar, including the ends of the bar.

The lower water component will typically be either physically and/or microbiologically incompatible with the higher water component and it must therefore be protected from it by means of a barrier layer. If the lower water component were not so protected from the higher water component, then water migration would occur causing the lower water component texture to become soft or soggy, and shortening the shelf life of the product by allowing microbial growth to occur. Typically the lower water component has a water activity of less than 0.83, preferably less than 0.6.

Typically the lower water component will comprise 10-75% by weight of the food product, preferably 25-70% by weight. The lower water component of the food product may be fortified to include vitamins, minerals such as calcium, dietary fibre, or live cultures such as probiotic cultures. It may also contain additives normally used in food manufacture such as antioxidants, emulsifiers, preservatives, stabilisers, and sweetening agents.

The lower water component may be made of any suitable food product or food ingredient that provides the necessary stiffness and integrity. It is preferably co-extruded around the higher water component and the barrier portion, and the extruded product may then be cooked if necessary. The lower water component may for example be based on any one of the following: a dough-based or cereal-based composition, which would require cooking after extrusion; an egg-based composition; a chocolate-based composition; a recombined fruit composition; a sugar-based composition; a nut-based composition; or a blended gum composition.

Examples of suitable dough-based or cereal-based compositions include: biscuit, crispbread, wafer, pastry, cake, pizza base, batter, bread, pasta, poppadom, rice cake, maize starch, pancake roll, flapjack, bagel, waffle, crumble, or croissant. The dough-based or cereal-based composition may be flavoured with any suitable sweet or savoury flavouring agents. An example of a suitable egg-based composition is a meringue. A chocolate-based composition could be used as a lower water component by itself or it could be part of a composite lower water component that also contained a dough-based or cereal-based composition. For example the lower water component could be a dough-based or cereal-based composition enrobed in a chocolate-based composition, or the lower water component could be a chocolate-based composition containing inclusions of a dough-based or cereal-based composition. An example of a suitable nut-based composition is a coconut composition.

The higher water component, or in some preferred embodiments, the filling, consists of a high moisture layer which would not be compatible with the lower water component in the absence of a barrier layer. It may have a water activity of up to 0.999, subject to the limitations imposed by the need for microbiological stability over the required shelf life under the conditions under which the food product is to be stored. The skilled person is readily able to determine the limitations on the water activity of the higher water component according to the pH of the higher water component and the mode of storage. Where the pH of the higher water component is 4.5 or lower, the higher water component preferably has a water activity of up to 0.999. If the pH of the higher water component is greater than 4.5, the higher water component preferably has a water activity of up to 0.96 in the case of a chilled product, or up to 0.93 in the case of an ambient product.

The higher water product may be based on a sweet food product or on a savoury food product, and it may be a composite food product consisting of one or more food products in combination. It is typically a soft food product that needs to be supported and contained within the lower water component. The higher water component of the present invention may have a higher water activity (aW) than the higher water component of known products, due to the presence of the barrier. Preferably the higher water component contains a humectant to bind the water and further reduce the possibility of water migration. Suitable humectants are fruit-based preparations, for example the product known as Fruitrim (TM), polyols, or sugars.

Typically the higher water component comprises 10-70% by weight of the snack food product, preferably 12-50% by weight. The higher water component of the snack food product may be fortified to include vitamins, minerals such as calcium, dietary fibre, or live cultures such as probiotic cultures. It may also contain additives normally used in food manufacture such as antioxidants, emulsifiers, preservatives, stabilisers, and sweetening agents.

The higher water component may be any suitable sweet or savoury food product or combination of food products. If the lower water component is one that needs to be cooked, for example a dough-based or cereal-based composition, then the higher water component must be stable to the cooking process used, either naturally or by the addition of suitable stabilising agents. The skilled person is readily able to choose such stabilising agents as are known in the art. The higher water component may for example be based on any one of the following: a dairy-based composition; a fruit-based or vegetable-based composition; a fish-based or meat-based composition; a sauce-based composition; or a

dessert or pudding composition. The higher water component may also be a composite layer based on any suitable combination of any of the foregoing compositions.

Examples of suitable dairy-based compositions include: yogurt, fromage frais, soft cheese, cheesecake, stabilised cream, cheese spread, cottage cheese, cream cheese, or cheese-based compositions. Examples of suitable fruit-based and vegetable-based compositions include: fresh fruit, fruit conserves, jam, fresh vegetables, coleslaw, baked beans, or vegetables in mayonnaise. Examples of suitable fish-based and meat-based compositions include: prawns, tuna, salmon, sushi, minced beef in bolognese sauce, chicken, a meat-based emulsion, or ham and cheese, the latter being a combination of two types of food compositions. Examples of suitable sauce-based compositions include tomato ketchup, mayonnaise, caramel, or other sweet or savoury sauces. Examples of suitable dessert or pudding compositions include: custard, mousse, rice pudding, jelly, creme caramel, ice cream, treacle, or marshmallow.

Preferably the higher water component is based on a dairy product, for example a stabilised yogurt or fromage frais.

The barrier must be sufficiently impermeable to water to prevent or hinder the migration of moisture from the higher water component to the lower water component and thus to maintain the physical and microbiological integrity of the product over the required shelf life. The barrier must substantially separate the higher water component from the lower water component to ensure that there is little or no migration of water. The barrier may be indistinguishable from the higher water component to the eye or it may be flavoured or textured so that the consumer can distinguish it as a feature of the product. Typically the barrier layer will comprise 2-50% by weight of the snack food product, preferably 4-40% by weight, more preferably 4-20% by weight, most preferably 4-10% by weight.

The barrier may suitably be a fat or a fat-continuous emulsion. Examples of suitable fats are hardened palm kernel oil or coconut oil, and examples of suitable fat-continuous emulsion barriers include fat spreads or chocolate. Other types of barrier may be used as long as they are sufficiently impermeable to water transfer under the conditions in which they are used, that is the specific combination of lower water component and higher water component and the required shelf life of the product. The barrier material must also be capable of being extruded such that it can form a continuous layer enclosing the high water component. Where the outer layer is to be baked, the barrier must be capable of maintaining its integrity during the baking process. Examples of non-fat barrier layers that may be used include: marzipan, jam, gelatin, gums such as alginate, methyl cellulose,

proteins such as zein or denatured whey protein, edible waxes or shellac. Under certain circumstances it may be possible to use cheese spreads or mayonnaises as non-fat barriers. Preferably the barrier comprises shellac or a fat-continuous emulsion. The barrier should have a water activity (aW) of no greater than 0.93, and preferably no greater than 0.90, in order to be microbiologically stable.

Each component of the snack food will typically be formed or processed separately before being combined, for example in an extruder. The higher water component will typically be prepared, pasteurised at a temperature of 72-90°C for 15-300 seconds, and cooled to a temperature of 5-65°C before being fed to the extruder. The exact conditions used will depend on the nature of the higher water component and the required shelf life of the food product. The skilled person may establish the necessary conditions. The barrier is typically pasteurised at a temperature of 72-90°C for 15-300 seconds, and cooled to a temperature of 5-40°C before being fed to the extruder. Again the exact conditions will depend on the nature of the barrier layer, and the skilled person will know how to establish them based upon standard processes in the art. In most cases the lower water component is prepared by blending and/or other treatment, but it is not generally cooked before being fed to the extruder though it may need to be heated. The exact conditions will depend on the nature of the lower water component, and the skilled person may readily determine what conditions are necessary. The exact conditions used for any of the components will also depend on whether the food product is a chilled product, a frozen product or an ambient product; the skilled person may easily determine how to vary the conditions according on the type of product to be produced.

The snack food product is preferably made by co-extrusion from a suitable extruder, such as those manufactured by the Rheon company. In this aspect of the invention, it is important that the extruder used is capable of reliably ensuring both the integrity of the barrier layer and its complete coverage of the higher water component, and the integrity of the lower water component and its complete coverage of the barrier layer.

After the snack food product has been extruded it is typically cooked at a high temperature for a short time, for example in an oven, by deep frying or by the use of microwave technology, cooled and wrapped. The exact conditions used will depend on the nature of the lower water component, and the skilled person may establish these conditions from his knowledge of conventional processes. It is important that the cooking process is fairly rapid, using a high temperature for a short time, in order to minimise the heating of the higher water component while ensuring that the lower water component is properly cooked.

The invention will now be described by way of example only with reference to the following specific embodiments.

The example describes the preparation of a snack food product consisting of an outer layer of a flapjack composition, a barrier layer of fat, and an inner layer of a cheesecake composition.

Flapjack Outer Layer

Oats	28.0%
Demerara Sugar	21.0%
Plain Flour	18.0%
Glucose Syrup	13.0%
Butter	9.0%
Golden Syrup	5.0%
Pasteurised Egg White	3.0%
Fruitrim (TM)	3.0%

[Fruitrim is a fruit-based fat replacer with humectant properties from Hax Ltd]

The butter was melted in a pan at 40°C, and the demerara sugar, glucose syrup, golden syrup and Fruitrim were added. The oats and plain flour were combined and half of the amount was added to the pan and the contents were stirred well. The egg white and the remainder of the oats/flour mixture were then added while continuing to stir the mixture, which was then passed to the extruder.

Fat Barrier Layer

Hardened palm kernel oil was used as the fat layer, or alternatively coconut oil could be used. The fat was heated to 90°C for 20 seconds in a swept surface heat exchanger and cooled to below 5°C, before being passed to the extruder.

Cheesecake Inner Layer

Quarg (0.2% fat)	55.0%
Sugar	12.0%
Soured Cream	10.0%

Full Fat Soft Cheese (30% fat)	8.0%
Whole Egg	5.0%
Skimmed Milk Powder	4.0%
Water	4.0%
Gelatin (240 bloom)	1.0%
Cloudy Lemon Concentrate	0.5%
Ultratex 4 (TM) Starch	0.5%

The dry ingredients except for the gelatin (sugar, starch, skimmed milk powder) were blended together. The liquid ingredients except for the water (whole egg, full fat soft cheese, quarg, soured cream, lemon concentrate) were blended together, and the preblended powders were then added and stirred well. The gelatin was dissolved in the water with heating, and the gelatin solution was added and mixed in. The cheesecake was then pasteurised at 80°C for 15 seconds in a scraped surface heat exchanger and cooled to below 5°C, before being passed to the extruder.

Extrusion

The three layers were then combined on a Rheon Encruster (TM) to form bars, the flapjack outer layer being handled at 40°C and the fat barrier layer and cheesecake inner layer at below 5°C. The co-extruded bars were then placed on trays and cooked at 280°C for 5 minutes in a travelling oven. After cooking, the bars were cooled as rapidly as possible in order to minimise degradation of the fat barrier layer, and flow-wrapped.

Final Product

The final product was a snack food product in the form of a chilled dairy bar consisting of 69.6% by weight of a flapjack outer layer, 6.5% by weight of a fat barrier layer, and 23.9% by weight of a cheesecake inner layer, and it had a 30 day shelf life under refrigeration. The inner layer was of a higher water content than the outer layer, which was protected by the barrier layer which acted as a physical and microbiological barrier.

CLAIMS

1. An extruded food product comprising a higher water component, a lower water component and a barrier portion separating the higher water component and the lower water component, wherein the barrier portion has a water activity of 0.93 or less, the barrier portion is capable of restricting the migration of water from the higher water component to the lower water component, the barrier portion substantially encloses the higher water component, and the lower water component substantially encloses the barrier portion.
2. A food product according to claim 1, wherein the barrier portion has a water activity of 0.90 or less.
3. A food product according to claim 1 or claim 2, wherein the barrier portion comprises a fat or a fat-continuous emulsion.
4. A food product according to claim 1 or claim 2, wherein the barrier portion comprises marzipan, jam, gelatin, gum, methyl cellulose, protein, edible wax or shellac.
5. A food product according to any preceding claim, wherein the lower water component comprises a dough-based composition, a cereal-based composition, an egg-based composition, a chocolate-based composition, a recombined fruit composition, a sugar-based composition, a nut-based composition or a blended gum composition, or any combination thereof.
6. A food product according to any preceding claim, wherein the higher water component comprises a dairy-based composition, a fruit-based composition, a vegetable-based composition, a fish-based composition, a meat-based composition, a sauce-based composition, a dessert composition or a pudding composition, or any combination thereof.
7. A food product according to claim 6, wherein the higher water component comprises a dairy-based composition.
8. A food product according to any preceding claim, wherein the higher water component further comprises a humectant.
9. A food product according to any preceding claim, wherein the food product is a perishable product that is required to be stored under refrigeration.

10. A food product according to any of claims 1 to 8, wherein the food product is a non-perishable product that can be stored at ambient temperature.

11. A food product according to any preceding claim, wherein the higher water component has a water activity of up to 0.999.

12. A food product according to claim 11, wherein the higher water component has a water activity of up to 0.96.

13. A food product according to claim 12, wherein the higher water component has a water activity of up to 0.93.

14. A food product according to any preceding claim, wherein the higher water component has a pH of 4.5 or lower.

15. A food product according to claim 12 or claim 13, wherein the higher water component has a pH of greater than 4.5.

16. A food product according to any preceding claim, wherein the food product is a hand-held product.

17. A food product according to any preceding claim, wherein the food product is a sweet product.

18. A food product according to any of claims 1 to 16, wherein the food product is a savoury product.

19. A process for preparing a food product, which process comprises forming a higher water component, a lower water component and a barrier portion separately and then co-extruding to form the food product, such that the barrier portion substantially separates the higher water component and the lower water component.

20. A process according to claim 19, wherein the food product is a food product as defined in any of claims 1 to 18.

21. A food product obtainable by a process as defined in claim 19.



INVESTOR IN PEOPLE

Application No: GB 0013685.3
Claims searched: 1-21

12
Examiner: Peter Trickey
Date of search: 29 November 2000

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
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Int Cl (Ed.7): A21C 3/04, 11/16; A21D 13/00, 13/08; A23G 3/00, 9/00; A23P 1/08, 1/12
Other: Online: EPODOC, WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 0421509 A1 (Unilever) line 30 page 1 to line 52 page 2 and lines 39-40 page 6	1-21
X	EP 0162644 A2 (United Biscuits) Figures 3 and 5c, and lines 29 page 3 to line 7 page 5, lines 14-33 page 8, line 32 page 9 to line 7 page 10 and lines 13-18 page 10	1-21
X	US 4748031 A (Koppa) Figures 1-2 and column 3 lines 24-49 and column 5 lines 9-14 and column 8 lines 35-42 and claim 5	1-21

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
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